Microstructure of Advanced Magnetic Recording Thin Film Media for 35Gb/in^2

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Introduction: In the past few years it has become evident that thermal stability may place a limit on longitudinal magnetic recording aerial density with predictions of a maximum data density limit ranging from 36 to 100 Gbits/in^2 [1, 2]. Recently, however, IBM [3] has demonstrated the ability to write and read data at 35 Gbits/in^2 using magnetic media that are thermally stable and have a high signal-to-noise ratio (SNR). One important question is: what are the key aspects of the media microstructure that contribute to the thermal stability and the high SNR? X-ray diffraction measurements were performed to provide some insight into this and to address the suitability of conventional Co-alloy media for even higher aerial densities.

Results: The diffraction results point to several microstructural aspects that result in favorable recording properties. First, the demonstration media have an extremely low level of fcc-like defects (stacking faults) in the hcp magnetic alloy (e.g., <2% compared with about 10% for the 10Gbit/in^2 media [4]). This is evident in Figure 1, since the (10.1) and (10.2) peak widths are the same as the (10.0) and (00.2) widths. This low defect level contributes to the high coercivity and small distribution in magnetic switching volumes [5]. Second, the demonstration media has a very high degree of preferred orientation (e.g., small rocking curve width), as is evident from Figure 2. Specifically, the demonstration media has a rocking curve width of 5 degrees compared to 7.5 degrees typically seen on AlMg substrates and 20-25 degrees for NiAl seed layers (such as the 10Gbit/in^2 media) [4]. This strong preferred orientation results from the choice of the particular seed layers, underlayers and deposition conditions. It leads to an excellent in-plane c-axis preferred orientation that results in high coercive square ness for good overwrite properties. It may also contribute to improved thermal stability through indirect effects such as the small grain size distribution, the Cr segregation and lack of fcc-like defects. Third, there is no evidence of vertical c-axis oriented grains where typically 5-10% would be observed for media grown on NiAl seed layers. This contributes to the high SNR, as shown by past evidence. Finally, consistent with previous TEM results, the X-ray measurements indicate a reasonably tight distribution of physical grain sizes.

Conclusions: These data together with the magnetic recording data suggest there is room for further increase in aerial density using conventional Co-alloys. This optimism is based on the low defect level in the media, the improved grain size distribution, and the resulting good thermal stability.

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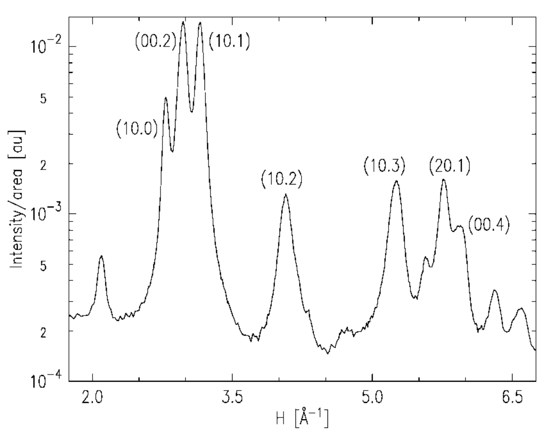

Figure 1. In-plane (grazing incidence) diffraction pattern from the demonstration disk. Some of the (hcp) diffraction peaks have been indexed.

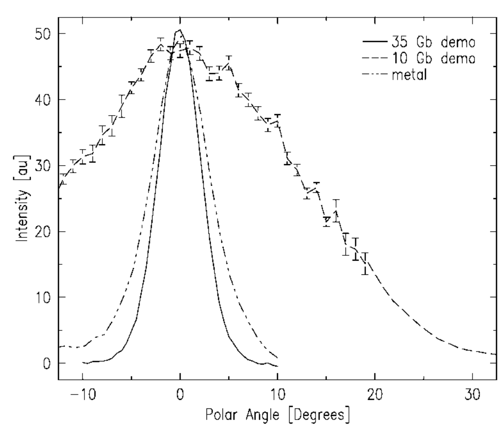

Figure 2. Angle scans of the 35Gbit/in^2, 10Gbit/in^2 and typical metal-substrate media. The 35Gbit/in^2, and metal-substrate media have (11.0) preferred orientation, while the 10Gbit/in^2 media had (10.0) preferred orientation.